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Assuming the perception of similarities as a fundamental psychological process, the applicability of a multidimensional scaling, nonmetric technique called MAPP (Mathematical Analysis of Perception and Preference) is demonstrated using three case studies. Any technique which provides paired similarity ranks can be used to collect data necessary for MAPP input. From the set of similarity ranks and preference rank, MAPP determines: (1) the subject's perception of what is relevant in the stimulus, (2) clusters of perceived objects in terms of the attributes considered, (3) clusters of respondents, and (4) different perceived ideals and clusters of people sharing each ideal. In the first case study, hypotheses of perceptual congruency were tested, with four perceptual styles differentiating among Elementary and Secondary Education Act Title III administrators. The results of the second case study suggest that, in an occupational hierarchy, "agressive noncompliance" is more characteristic of top-rung members, and compliance to institutional norms upon request is more characteristic of lower rung members. Data analysis for the third study is not complete. Since MAPP does not require verbal or introspective responses, and attempts to elicit how respondents feel about stimuli in relation to each other, affective measurement implications become apparent. (PS)

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Multidimensional nonmetric measurement of perception and preference --- three case studies

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In reviewing traditional scaling methods, Greene, Carmone and Robinson[1] suggest two limitations: emphasis on the unidimensionality of the attribute space and the strong assumptions underlying input data when one desires interval or ratio scales. Oppenheim and others previously described these assumptions and/or limitations[2,3] and Getzels proposed another[4] --- the assumption underlying authenticity of subject response. Among the purposes of an unreported feasibility study,[5] later amplified in a dissertation,[6] was one of demonstrating the applicability of a multidimensional scaling, nonmetric technique developed in market research to educational research. Called MAPP (Mathematical Analysis of Perception and Preference), this technique is also presently being used in a state-wide educational-needs assessment in Pennsylvania under ESEA Title III.[7] In the latter, the non-verbal potential of the technique is also being demonstrated through the use of photographs as stimuli.

What is MAPP? A Brief Review for the Layman or the Uninitiated[8]

"Our own experiences, common sense, and psychological research tell us that no two people see the world exactly the same way. Rather, our varying biological, cultural, social, and personal histories lead us to pay attention to different aspects of our environment and to evaluate in our own way what we perceive. Meaning, as well as beauty,

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is in the eye of the beholder.

"Sometimes these differences of perception and evaluation can be troublesome. As people become more interdependent, these differences can cause poor communication, friction, distrust, and occasionally social breakdown. In intimate family relationships, international diplomacy, education, race relationships, organizational decision making, and many other areas, these largely unrecognized private world views interfere with our ability and hamper our desire to behave productively in a complex society.

"There have been many attempts to 'get inside someone else's head' and see the world as he sees it. These attempts range from psychoanalytic studies to projective tests like the Rorschach (and) to asking people directly what they think, as in political polls. The techniques are based, in part, on the respondent's ability to introspect and to be articulate about the results of that introspection. Many of these approaches work quite well, many are poorly or inappropriately used. The MAPP system represents a recent addition to the methods available for attacking this important and difficult problem.

"MAPP (Mathematical Analysis of Perception and Preference) grew out of psychometrics. It is based on the idea that the perception of <u>similarities</u> is a fundamental psychological process. If I know that you think Charles Dickens a lot like Herman Melville, but that Henry James is very different from each of them, I know something of your view of 19th century novelists. If I pick, say, nine or ten novelists and have you rank them in terms of similarities to each other and then get you to rank them from best to worst (or most preferred to least preferred), I have <u>all</u> the data I need for a

typical MAPP analysis. There are many ways to collect the data necessary for MAPP input. Any technique (rating or ranking) that provides paired similarity ranks can be used. The one most often used requires the respondent to take a stimulus as the 'standard,' and then pick one of the other stimuli as most similar --- the criteria of similarity are left entirely up to the respondent. The respondent then picks from the remaining stimuli the one most similar to the standard, and so on, until all the stimuli have been ranked in order of their similarity to the standard. Then another stimulus is selected as the standard and the other stimuli are ranked against it, and so on until each stimulus has served as a standard or 'anchor point.' Then the items are ranked once as to preference. This method usually takes about a half an hour and has often been used with groups of respondents. The data collection costs are usually much less than typical interviewing methods. MAPP takes as input this set of similarity ranks and preference rank and determines from them:

1. The number of attributes used by the respondent to rank the similarities; that is, what he perceives as relevant in the stimulus.

2. Any clusters of perceived objects (in this illustration, 19th century novelists). That is, how the stimuli cluster together in terms of the attributes considered.

3. Any clusters of respondents. How many ways of seeing nevelists are there and how many people see them each way?

4. What are the characteristics of an Ideal novelist? How many different ideals are there and how many people share each ideal?

"These questions are answered without asking the respondent any clarifying questions, or indeed, any questions at all. These questions are answered solely from analysis of the rank order com-

parison of the stimuli. Without going into any of the mathematical details,[9, 10, 11] this analysis makes use of the excess information contained in the ranking of every stimulus with every other one."

Three MAPP Case Studies --- Procedures

From more than 200 ESEA Title III funded projects in four participating states (New Jersey, New York, Delaware and Pennsylvania), an abstract-of-project stimuli-array of diverse educational activities[12] was selected for the initial feasibility study. With geographic and other identifications removed, the array was presented to ESEA Title III staff in four state education departments (N = 40) and in the U. S. Office of Education (N = 10) to test several hypotheses concerning congruency of perceptions and preferences relating to ESEA Title III intents. Using these responses as pre-data, a dissertation study[13] provided institutional-goal "treatment" and gathered post-data using the same stimuli and 28 of the same respondents (total post-data N = 36) to test participant ability to demonstrate institutional-goal behavior on request. After post-testing, USOE staff in two separate jury-judging sessions provided similar "ideal MAPPs," against which all pre- and post-MAPPs were compared. The third application of MAPP, a need-assessment study now nearing Phase I completion, used 5 x 7 glossy photographs as stimuli.[14] The photographs depicted various growing-up, formal and informal educational activities, process and product oriented, to which various audiences (N = 3000) in Pennsylvania responded. The audiences included fifth and eleventh grade children, parents, teachers, administrators and community influentials in a stratified sample.

Results

The first two studies are completed. Both successfully demonstrated the efficacy of MAPP as a technique to describe perceptual/

preferential profiles relating to educational problems. The third study, originally sheduled for completion circa December 31, 1968, was delayed approximately six weeks due to data collection problems. Data is now being analyzed and a study report will be available on or before March 31, 1969.

Case Study #1

Feasibility-study data was analyzed with TRICON,[15] TORSCA,[16] and the Howard-Harris Clustering Routine,[17] the latter using Euclidean distance as proximity measures. TRICON, a Coombsian method to triangularize conjoint data, provided the proximity measures which, in this case, consisted of 28 paired-stimuli similarity measures for the eight stimuli used. The Howard-Harris

> grouping principal is hierarchical and (is) based on the attainment at each stage of minimal within-cluster variance, summed over all clusters...The objects are first split into two groups according to the single characteristic displaying the largest variance. Objects are then shifted from cluster to cluster until the minimum variance criterion is satisfied. The cluster containing the larger variance is next split into two clusters and objects are again distributed over clusters in accordance with the minimum variance criterion. 17

Four clusters were judged as optimum (Howard-Harris could provide up to 20) from the 47 useable sets of subject responses. Each cluster contained subjects whose perceptual style --- their way of "seeing" the stimuli --- was more like each other's style in the common cluster than subject styles in the other three clusters. Tables 1, 2, and 3 illustrate the distribution of styles.

Table 1. Distribution of Subjects by Perceptual Style

Style	Number of Subjects	Percent
1	9	19%
2	13	28%
3	6	13%
4	19	40%
Total	47	100%

Table 2. Distribution Among Perceptual Styles by State

Style	Expected Percent N = 47	Actual Percent Pa N = 16	NY N = 8	NJ N = 4	Del N = 8	Va N = 1	OE N = 10
1	19%	12.5%	12.5%	25.0%	12.5%	0 %	40%
2	28	25.0	25.0	0	62.5	0	20
3	13	12.5	12.5	25.0	25.0	0	0
4	40	50.0	50.0	50.0	0	100	40
	100%	100%	100%	100%	100%	100%	100%

Table 3. Distribution of Perceptual Styles by Administrative Levels (excluding all Delaware subjects)

	All Subjects		PERCENT OE Mgmt	OE Area	State Mgmt	State Staff	Local
Style	N	%	N = 3	N = 7	N = 6	N = 9	N = 9
1	8	21%	100%	14%	16.7	11	22
2	8	21	-	29	-	11	-
3	4	10	-	-	33.3	11	11
4	19	48	-	57	50.0	67	67
	39	100%	100%	100%	100%	100%	100%

Table 3 does not include the Delaware subjects since they appeared to be acting quite differently from the others. If Delaware were included, then Table 3 would be as follows:

Table 3a. Distribution of Perceptual Styles by Administrative Levels (all subjects)

	All Subjects		OE Mgmt	OE Area	State Mgmt	State Staff	Local
Style	N	%	N = 3	N = 7	N = 8	N =18	N = 11
1	9	19%	100%	14%	12.5%	11.1%	18%
2	13	28	-	29	12.5	50.0	9
3	6	13	-	-	37.5	5.5	18
4	19	40	-	57	37.5	33.3	55
	47	100%	100%	100%	100%	99.9%	100%

Case Study #2

Unlike the feasibility study data, the analysis of which focused on "style" and not on responses (i.e., how the subjects responded, not what their responses were), the ensuing dissertation study analyzed response frequences of the single-sort preferential vector. Additionally and moving away from the responses per se,[18] the second study also used Spearman rank-difference correlation coefficients to test the degree of association among subjects' multiple-sort perceptual configurations and between a single subject's configuration and the USOE jury-judged "ideal" institutional-goal oriented configuration. Using the Carroll-Chang program,[19] this study further tested for "goodness of fit" between a subject's preferential vector and his perceptual configuration as provided in a (TORSCA) simple-space analysis of the multidimensional scaling. The mean correlation (goodness-of-fit statistic) for 25 subjects in pre-MAPPing was .97; for the same 25 subjects in post-MAPPing it was .955.

In addition to providing similarity measures and serving as a preprocessing program for simple-space analysis, TRICON also furnishes an index of subject inconsistency in repetitive perceptual sorts. Called intransitivities, they (along with "stress" indices generated in TORSCA simple-space analysis when multidimensional scaling is reduced to two dimensions) were used in the second study as indicators of cognitive dissonance. Up to ten per cent sort inconsistency and up to ten per cent two-dimensional stress were arbitrarily selected as acceptable indicators of normal cognitive dissonance when dealing with the eight stimuli used. Table 4 depicts pre- (feasibility-study data) and post-preferential frequency percentages of responses to four stimuli (1,4,5,8) containing national-priority cues (i.e., institutional goals).

Table 4

PERCENTAGE OF PRE-/POST-PLACEMENT OF NATIONAL PRIORITY STIMULI IN FIRST FOUR PREFERENCES, BY STIMULI NUMBER AND ACROSS GROUPS

Pre-Nat'l Prior. Stimuli	USOE Admin. (N=5)	USOE Prog. (N=5)	State Coord. (N=6)	State Middle Mgm't (N=10)	State Newer Staff (N=5)	State Reg'l Staff (N=12)	Placement Average (N=43)
1	100	80	100	70	100	58.3	79.1
4	40	80	83.3	40	100	91.7	72.1
5	80	80	100	80	100	91.7	88.4
8	40	60	83.3	70	80	58.3	65.1
Total	65	75	91.6	65	95	75	76.2
Post Nat'l Prior. Stimuli	**USOE Admin. (N=6)**	**USOE Prog. (N=6)**	**State Coord. (N=4)**	**State Middle Mgm't (N=4)**	**State Newer Staff (N=4)**	**State Reg'l Staff (N=12)**	**Placement Average (N=36)**
1	66.6	100	100	100	100	91.7	91.7
4	100	83.3	100	75	50	91.7	86.1
5	100	100	75	100	100	100	100
8	33.3	100	100	100	100	75	77.7
Total	75	95.8	93.7	93.7	87.5	89.6	88.9
Pre/ Post Gain	10	20.8	2.1	28.7	7.5*	14.6	12.7

*Net Loss

Table 5 depicts participating subgroup correlations for idiosyncratic (pre-test) and institutional-goal oriented (post-test) perceptual responses.

Table 26 5

GROUP MEANS OF SPEARMAN R-D CORRELATION COEFFICIENTS[1], PERCEPTUAL DATA[2]

Variables Correlated	USOE Admin. Staff	USOE Program Staff	State				Mean Sp. R-D "r" For All Groups
			Coord-inators	Middle Mg't.	Newer Staff	Regional Staff	
1. Same Subjects' Pre and Post (N=28)	.422	.464	.461	.344	.360	.293	.372
2. Subjects' Pre and OE Program Jury (N=28)	.402	.587	.395	.358	.412	.262	.374
3. Subjects' Post and OE Program Jury (N=28)	.302	.350	.395	.500	.460	.554	.454
4. Subjects' Post and OE Program Jury	.486	.344	.395	.500	.460	.624	.458[3]

[1]Two variable r, 26 d.f., alpha .05, r ≠ o, requires a minimum r of .374

[2]First eight sorts of eight stimuli = 28 pairs of stimuli for similarity/ dissimilarity ranking.

[3]The mean correlation for all groups with the OE Administrative Jury (N=36) was .428.

Table 6 illustrates subgroup movement, pre to post, toward the jury-judged institutional-goal perceptual "ideal."

Table 6

PERCENTAGE OF GROUP MOVEMENT[1] TOWARD (AWAY FROM) JURY "IDEAL" PERCEPTUAL SEQUENCES[2]

Movement Toward (Away From)	USOE Admin. Staff	USOE Prog. Staff	State				Average Movem't For All Groups
			Coord.	Middle Mg't.	Newer Staff	Reg'l Staff	
OE Program Jury (N=28)	(24.9)	(40.4)	0	28.4	10.4	52.7	17.6
OE Program Jury (N=36)	17.3	(41.4)	0	28.4	10.4	58.0	18.3

[1] As determined from comparison of pre-group and pre-total means (N=28) with post means (N=36), using the formula:

$$\text{Per cent Movement} = 100 \left[1 - \frac{\text{smaller } r}{\text{larger } r}\right]$$

Should the numerator be a pre-r, movement is toward the jury ideal sequences. Should it be a post-r mean, movement is away (percentage enclosed in parentheses) from the "ideals."

[2] Ninth and only sort of the PACE abstract stimuli for preference --- from most to least preferred. The first eight sorts are perceptual.

Table 7 suggests the amount of cognitive-dissonance reduction that took place, pre to post, when all post-test subjects (including USOE participants) were asked to role-play Washington, D. C. "official ESEA Title III norms" (institutional goals), i. e. to simulate USOE thinking re: the ESEA Title III abstract array. (The acceptable ten per cent intransitivities limit is equal to 17 intransitivities.)

Table 7

COMPARISON OF PRE-/POST-INTRANSITIVITY MEANS (TRICON) AND STRESS MEANS (TORSCA)

Participant Groups	Pre-Test (N=47)		Post-Test (N=36)	
	Mean Number Intransitivities	Mean Per Cent Stress	Mean Number Intransitivities	Mean Per Cent Stress
USOE Admin.	21.4	10.8	19.6	11.3
USOE Program	23.6	12.6	16.5	12.1
OE Total	22.5	11.7	18.1	11.8
State Coordinators	14.9	8.7	8.8	8.0
Middle Mgm't.	18.7	11.0	23.0	11.5
Newer Staff	15.3	10.6	10.5	5.7
State Total	16.7	10.2	14.1	8.4
State Regional	21.2	11.5	15.2	9.3
Mean of All Groups	21.2	10.9	15.8	9.7

Case Study #3

Data analysis in this significantly larger study (N = 3000), although not yet complete, will be more discriminating and use more MAPP subroutines (there are 50+ routines in the MAPP package, presently) than did the previous two studies. Clustering analysis of the eight sets of eight photographs (32 process-oriented, 32 product-oriented, all of which were selected using an extensive array of criteria --- racially mixed groups, non-mixed children, formal and informal activities, in-school and out-of-school, etc.) will use correlation coefficients instead of proximity measures as in H-H.

Interpretation

In the feasibility study (Case Study #1) wherein hypotheses of perceptual congruency were tested, four different perceptual styles distinguishing ESEA Title III administrators appeared.

The Program Transmission System

"...All Office of Education top management shared one perceptual style; the state top management tended to share a second perceptual style; a third perceptual style tended to be that of those new to Title III management; and the fourth and dominant style was that of the program implementors. This last style included personnel at all administrative levels (except OE top management) from OE Area Desk (staff) to local project directors.

Program Consistency

"To the extent that one can consider consistency as a test of success, one can point to a unified approach by OE top management as a successful, coherent translation of Congressional intent of Title III purpose.

"This perspective is transmitted directly all the way down the line, from top management to Area Desk to State Management to Local Project Directors. In a narrow sense, therefore, one might say that the second test of OE management has been met: the ability to transmit its policy directly down the line.

"However, the existence of a state management style and a strong program implementor's style suggests that policy coherence is being transmitted through a chain with three distinct, though related strands: federal management; state management; and implementors.

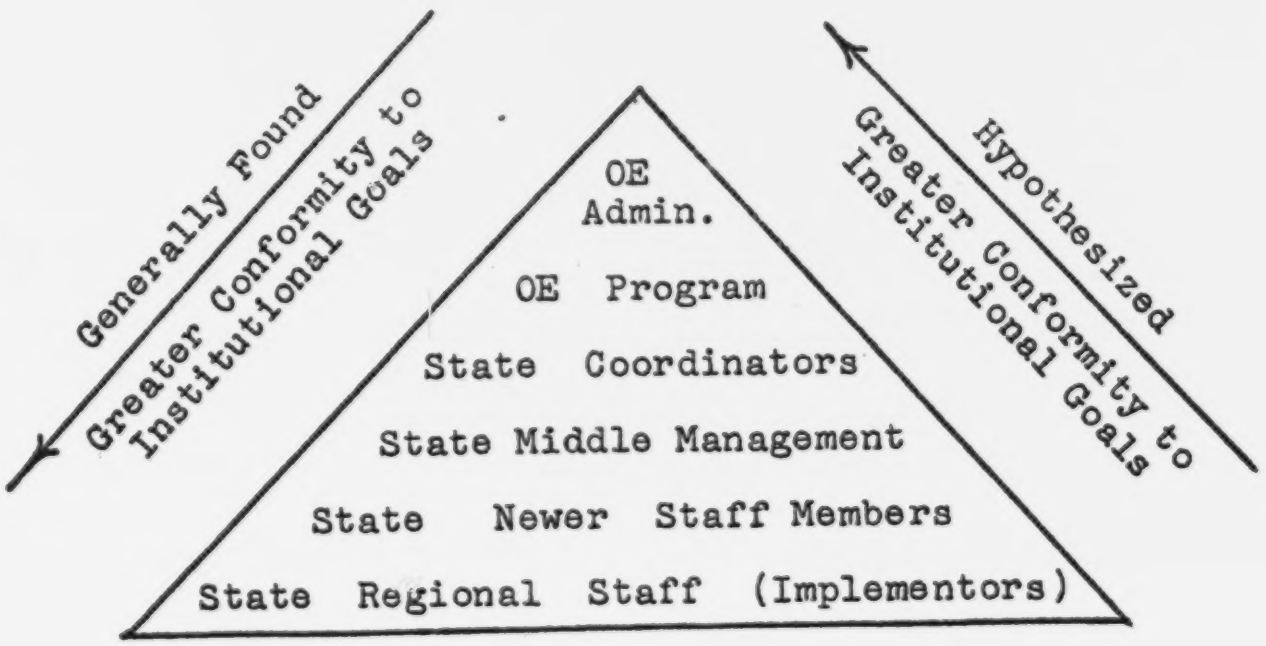
Creativity Down the Line

"What do these findings have to say about the problem of balancing policy coherence with creativity? We enter here into the grey

area of judgement. It is simple to identify a situation where management policies are being followed with simple-minded non-creativity: all the subjects would view all the projects in the same way as did top management. We do not have such a situation here. In the same way, it is simple to identify a situation where individual creativity hasrun away with the program: there would be no significant representation of the management view at other administrative levels. This, too, is not true of the Title III program.

"What is a 'good' distribution of management and program perspectives? This study cannot speak to that question, which is largely one of judgement, policy, and taste. All this study can demonstrate is that the administrators involved in the Title III program do not fall into the extremes either of docile overcompliance or aggressive noncompliance."[20]

Additional evidence gathered for Case Study #2 suggests that, in terms of occupational hierarchy,"aggressive noncompliance" may be more characteristic of the top-rung members and compliance to institutional norms upon request may be more characteristic of lower-rung members. The following figure illustrates study #2's hypotheses concerning occupational hierarchy and study-results:



Three possible explanations for the reversal of the hypothesized occupational hierarchy outcomes are suggested:

"1. In terms of in-group/out-group concepts in small-group theory, the higher occupational levels (the in-group) felt less compelled to conform to institutional-goal requirements; the lower groups felt more compelled to conform.

"2. In terms of power allocation concepts, the "vested power" levels similary felt less compelled to conform in order to accrue a greater share of power than did the lower, power-periphery levels who wish (generally) to increase their share of power.

"3. In terms of discretionary authority, the OE levels in the PACE (ESEA Title III) state-federal hierarchies had (and continue to have, despite legally mandated state transfer of PACE authority) the larger share of discretionary authority. The OE levels continued to display this occupationally natural authority even in this relatively minor PACE study. That such discretionary authority exists in OE has been documented...and biases (the investigator) toward it rather than the first two explanations suggested."[21]

Conclusion

"MAPP (Mathematical Analysis of Perception and Preference) has clearly proved to be a useful and relevant technique. It is acceptable as a data collection device and the insights derived from the data are provocative and useful."[22] The yet-uncompleted but more sophisticated discriminant analysis now underway for Case Study #3 tends to strengthen this conclusion. Since MAPP does not require verbal or introspective response and, in essence, attempts to elicit how respondees "feel" about stimuli in relation to each other, affective measurement implications are obvious.

Footnotes

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5. Michael H. Halbert, Corinne Silverman, Patrick F. Toole, Perceptual Style and Administrative Structure (Philadelphia: Institute for the Study of Inquiring Systems, September, 1968).

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13. A Comparison of ... Perceptions and Preferences, op. cit.

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17. Nigel Howard and Britt Harris, "A Hierarchical Grouping Routine --- IBM 360 Program," University of Pennsylvania Computer Center, October, 1966.

17a. Technical Manual, op. cit., pp. 246-247.

18. "Current interest centers not so much on the responses as on the relationships among them. These relationships, either among one subject's responses to different administrations of the same test or among different subjects' responses to the same test, are taken as indicators of higher-order constructs ... A cynic may see in this development slight cause for comfort, but it would seem that this shift to higher-order constructs is a sign of growing maturity." Darwin Cartwright, "Social Psychology and Group Processes," Annual Review of Psychology, Vol. 8 (1957), p. 212; cited in AERA's Encyclopedia of Educational Research (1960), p. 102.

19. "Relating Preference Data to Multidimensional Scaling ...," op. cit.

20. Corinne Silverman, in Perceptual Style, op. cit., pp. i-ii.

21. A Comparison of ... Perceptions and Preferences, op. cit. p. 128.

22. Perceptual Style, op. cit., p. ii.